RESIDUAL TOXICITY OF SOME INSECTICIDES AGAINST THE NEWLY HATCHED LARVAE OF THE PADDY BORER, *SCHOENOBIUS INCERTULAS*

By

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Tests conducted on the second paddy crop in Taipei in 1961 (Lee, 1961) showed that Sumithion gave excellent initial effect against the larvae of the paddy borer, *Schoenobius incertulas* Wlk., but was effective residually only for about one week. In the present tests persistence of Sumithion at a higher insecticide concentration and in combination with endrin was compared with parathion, EPN, and endrin. A brief discussion was made on the mode of action of residues of endrin and parathion on the newly hatched larvae. Trials were also conducted on the residual effect of these compounds when applied in a soil. Two field tests were carried out at Chiayi and Taipei to study residual control of the pest.

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MATERIALS AND GENERAL PROCEDURE OF RESIDUAL EFFECT TESTS.—The insecticides used in these tests were all in the form of emulsifiable concentrate; their active ingredients being as follows: Sumithion, 50%; parathion, 47%; EPN, 45%; endrin, 19.5%. The paddy plants used were variety Taichung No. 65, planted in pots, unless otherwise stated. The test larvae were those just emerged from the egg-clusters collected from paddy fields in Tainan and Chiayi districts. Sprays were applied with a hand sprayer (mosquito gun). Number of the test larvae released was 10 to 20 per hill of the plant unless otherwise mentioned. A counting of the withering tips or the ears caused by the larvae was made 4 days after releasing the larvae.

RESIDUAL EFFECT ON THE PLANT JUST BEFORE THE HEAD-FORMING STAGE OF THE FIRST CROP.—The plants were 60 days of age after transplanting when sprayed. No tiller came into the ear during the period of the test. Emulsions were applied at the rate of 17 cc. per hill, equivalent to 3,400 liters per hectare. The maximum temperatures during the test period ranged from 34 to 37°C. The results were given in table 1, which indicate that when 0.1 per cent concentration was used, Sumithion appeared to be somewhat superior residually to 0.05 per cent concentration, and that considerably better residual effect was obtained when it was combined with endrin. It does not seem necessary to use high concentrations when the two compounds are to be mixed, that is, 0.05 and 0.02 per cent appear to be adequate for Sumithion and endrin respectively. EPN at a higher concentration also showed promising residual effect. Endrin and parathion gave rather poor

residual effect in this test.

RESIDUAL EFFECT ON THE 30-DAY-OLD PLANTS OF THE SECOND CROP AND MODE OF ACTION OF RESIDUES OF PARATHION AND ENDRIN ON THE LARVAE.—The plants used in this test were planted directly in the paddy field, 30-day-old after transplanting when sprayed. The plants were caught b a typhoon on the 9th day after spraying. The maximum temperatures varied from 23 to 34°C.

Table 1. Residual effect of some insecticides for preventing the newly hatched paddy borer larvae from damaging the first paddy crop just before the head-forming stage. Sprayed on June 9, 1961. Taipei.
(1 to 2 hills examined in each treatment)

Treatment and Concentration (%) (17 cc/hill)		No. Of Tillers Whose Tips Withered/Total Examined (Larvae released at indicated days after spraying)					
		3	5	6.5	8	11	13
Untreated		3/110	8/75	8/49	11/65	11/38	7/27
Sumithion	0.1	0/82	1/76	1/44	2/44	4/36	2/44
	0.04	1/82	1/73	0/34	4/46	6/38	4/34
Sumithion Plus Endrin	0.1 0.04	1/85	0/74	0/28	1/41	9/44	1/35
Sumithion Plus Endrin	0.05 0.04	0/87	1/71	0/41	1/49	0/40	1/32
Sumithion Plus Endrin	0.1 0.02	0/95	0/79	0/45	2/45	5/53	0/43
Sumithion Plus Endrin	0.05 0.02	0/75	0/80	0/36	0/35	0/41	1/36
Endrin	0.04	1/98	1/48	1/41	5/48	11/48	2/36
	0.02	5/72	0/80	5/40	3/40	1/24	3/39
Parathion	0.05	4/81	0/76	0/35	3/39	2/31	2/32
	0.025	0/88	0/69	3/41	3/43	4/38	5/35
EPN	0.05	0/77	1/77	0/34	0/35	4/41	1/33
	0.025	1/91	0/81	2/39	7/50	3/45	4/46

during the test period. Table 2 summarizes the results. These data also suggest that Sumithion plus endrin may be residually better than Sumithion alone at 0.1 per cent concentration. Although some residual effect was still found in several treatments 11 days after spraying in the previous test, in this test little residual activity was observed in all the treatments. This may be owing to a lower dosage used or to the typhoon that occurred 9 days after spraying. When paddy plants are caught in a typhoon, the outer leaf sheaths will come off the stems or the straws, providing the invading newly hatched larvae with readier entrance into the interior part of the plants. It is worthy to discuss here the habit of the boring of the newly hatched paddy borer larvae into the the paddy plants and mechanisms by which the residues of insecticides may act on the larvae. As a rule, the majority of the larvae after hatching do not make an entrance hole on the outer surface of the plants, except on very young plants, but move here and there trying to find some openings on the plants through which they can readily crawl into some

Table 2. Residual effect of some insecticides for preventing the newly hatched paddy borer larvae from injuring the second paddy crop, 30-day-old after transplanting. Sprayed Sept. 2, 1961. Taipei.
(1 to 5 hills examined per treatment)

Treatment and Concentration (%) (6 cc/hill)		No. Of Tillers Whose Tips Withered/Total Examined (Larvae released at indicated days after spraying)	
		6	11
Untreated		4/19	12/111
Sumithion	0.1	1/22	19/98
	0.5	2/18	13/94
Sumithion Plus Endrin	0.1 0.04	0/29	10/130
Sumithion Plus Endrin	0.05 0.04	1/25	14/116
Sumithion Plus Endrin	0.1 0.02	0/31	14/122
Sumithion Plus Endrin	0.05 0.02	1/25	17/119
Endrin	0.04	0/24	25/125
	0.02	0/28	16/108
Parathion	0.05	1/31	19/128
	0.025	2/20	26/129
EPN	0.05	0/19	22/129
	0.025	0/30	15/96

sheltered spot to bore an entrance hole into the plant tissue for feeding. It was found from the tests conducted in Sept. 1961 that the surface residues of endriu or parathion did not appear to play an important part in killing the newly hatched larvae. In this test, the test larvae were released 41 or 48 hours after spray. The paddy plants used in these tests were about 5 days before heading stage. Their loose outer leaf sheaths were removed from the plants before spraying to eliminate open entrance for the test larvae. Most of the larvae when released crawled on the plants up and down for a while, then tried to move away by spinning, but they were artificially returned on the plants and kept walking on the surfaces for about 30 to 60 minutes, then removed to untreated fresh plants for feeding. Mortality count of the treated larvae was made 24 hours after releasing on the untreated plants. The results of these tests were shown in table 3. The data suggest that uptake of the residues of endrin on the surface of the plants through the legs of the larvae, if any, may be negligible in acting upon the larvae (normally it takes about 5 to 25 minutes for the newly hatched larvae to complete boring an entrance hole on the surface of the plants and get inside when they decide to make it instead of trying to find an opening on the plants). But, surface residue of parathion soon after spraying seems to show some toxic effect on the invading larvae. High mortality of the larvae in the untreated check plants seems to indicate that

death of the insect on treated plants was caused by exhaustion. Further studies will be made to settle this problem.

Table 3. Fate of the newly hatched paddy borer larvae after kept walking on the surfaces of the paddy plants sprayed with endrin and parathion 5 days before the heading stage.

Treatment (0.05%)	Per Cent Mortality Of The Larvae 24 Hours After Treatment[a] (Test larvae released on the plants at indicated hours after spraying)	
	41	48
Untreated	27 (4/15)	44 (20/45)
Endrin	18 (4/22)	51 (19/37)
Parathion	56 (5/9)	46 (12/26)

[a] Number of the dead larvae and the total examined were given in parentheses.

On the other hand, in these trials, many larvae remained on plants, quite a few of them could crawl into the part behind the outermost leaf sheaths, and some of them bored into the ear, though the opening at the top of the leaf sheaths was very slight. The fate of these insects 48 hours after releasing was shown in table 4.

Table 4. Fate of the newly hatched paddy borer larvae released on the plants (5 days before the heading stage) 41 to 48 hours after being sprayed with endrin or parathion. (Under laboratory conditions. Examined 48 hours after releasing)

Treatment 0.05%	No. Of Dead(D), Live(L) or Moribund(M) Larvae Found In The Parts Of The Plants Indicated		
	ON THE OUTSIDE	IN BETWEEN LEAF SHEATHS[a]	INSIDE THE GLUME(G) OR LEAF SHEATH(L)
Untreated	D. 5	0	L. 20 in G.
Endrin	D. 4[b]	D. 22	D. 4 in G.; M. 2 on G.; L. 2 in G.
	D. 18[c]	D. 26	0
Parathion	D. 2	D. 11	D. 1 in L.; D. 3 on G.
	0	D. 28	D. 5 in L.

[a] The larvae forced their way into this part through very slight opening at the top of the leaf sheath.

[b] One entrance hole was made on the surface of the straw, and the larvae were killed around the hole. Mortality seemed to be due to stomach poisoning.

[c] All the dead larvae were found around the ligule of the outermost leaf.

It was found from the data of table 4 that the larvae killed in between the leaf sheaths in both treatments were those sqweezed their way into the plants through the top of the sheaths. The mortality might be due partly to contact poison resulted from getting in tight contact with the toxicants that were present in a larger amount in the part around the ligule, as no feeding scar was observed

in the area where the larvae were found dead. The death of the larvae found inside the glume or the leaf sheath might also be owing to such contact with the residues before they got inside the plants. Such contact with the toxicant, however, does not seem great under natural conditions, because normally the outer leaf sheaths are coming off the stems or straws due to various causes such as aging, damage by winds or certain pests. As stated before, the majority of the larvae on such plants quickly crawl inside; and bore an entrance hole on the surface of the inner leaf sheath that is enveloped by the outer leaf sheath, or mine into the tissue of the outer leaf sheath from the inside. In the latter case higher mortality would result from stomach poisoning, because the leaf sheath in which they feed is directly exposed to the spray. But, in the former case, whether or not stomach poisoning takes place seems to be depending on the amount of the residues (penetrated or translocated from the part that was exposed to the spray) present in the part they first feed on, or may depend on the parts toward which their subsequent feeding proceeds (directly into the central part of the straw or eat lengthwise in the same leaf sheath on which they made an entrance hole. Higher mortality may result in the latter case). The presence or the amount of the residues in such "sheltered-parts" of the tiller that may be first fed upon by the larvae will be affected by many factors, such as character of the insecticides used, especially their penetrating or systemic effect, degree of openings on the plants, physiological conditions of the plants, amount of spray applied, and method of application. At any rate, to see how the residues of endrin and parathion act on the newly hatched larvae under natural conditions a test was conducted using the plants several days before the heading stage. In this test, no adjustment was made on the plants, that is, the loose outer leaf sheaths were not removed, and slight to medium openings between the leaf sheaths were left as they were. Sprays (0.05%) were applied on Sept. 24th. Test larvae were released on the plants 3 days after spraying. It rained soon after releasing the insects. The larvae were examined 24 hours after releasing. The results were examined on 15 hills per treatment; and are summarized as follows: in endrin treated plants 42 larvae were recovered, of them one bored into the leaf sheath through an entrance hole it made on the outside, and was alive; 25 crawled inside the plant through the openings behind the outer leaf sheaths and feeding already took place, of which 11 were moribund and 14 alive; 16 appeared to have crawled inside the plants through the opening on the flag leaf sheath, and were in the axis of the ear, all alive; (mortality 26%). In parathion treated plants, 40 larvae were recovered, of which one made an entrance hole on the surface of the straw and was killed in the spot; 16 crawled in behind the leaf sheath through an opening in its top, and all dead, though no feeding scar was found; 18 similarly reached behind the leaf sheath through an opening and already fed the tissues, all killed; 5 were found on the ear inside the flag leaf sheath, of which 4 were dead and 1 alive; (mor-

tality 98%). It seems from these results and the data of table 4 that residual effect of endrin varies more greatly with conditions of the plants than parathion.

RESIDUAL EFFECT OF SOME CHEMICALS ON THE SECOND CROP AT THE HEADING STAGE.—Three tests were conducted. The plants used in test one were planted in pots, and those used in tests two and three were planted in paddy fields. In order to standardize the test plants as much as poosible the outer leaf sheaths that were coming off the straws or severely injured by leafhoppers or other pests were removed a day before spraying. Emulsions were applied with a hand sprayer at the rate of about 6 cc. per hill. In all the tests, shooting up of the heads started several days after spraying. Table 5 summarizes the results of these tests. The data show that no great difference in residual effect may be found on 6th or 7th day after spraying between different treatments except Sumithion when used alone, and that residual activity of these compounds became negligible after the plants were exposed in a typhoon. Residual effect also appears to be much poorer on the plants that came into the ear. This seems to be owing to the fact that when the ear is partly emerging, almost all the newly hatched larvae crawl into the lower part of the ear that is still enveloped by the flag leaf sheath and eat in the glumes or in the axis of the ears in which little or nonlethal amount of the toxicant is present.

It is found from the data so far obtained that when applied as a foliar spray, no chemical tested gave satisfactory residual effect 10 days after treatment, and much less residual effect is obtained on the plants at the heading stage or after they are caught in a typhoon. The possible causes for such poor residual effect have already been discussed. In addition to such inevitable difficulties in securing good residual effect on the paddy plants, there arises another difficulty of applying chemicals by a foliar spray in a way to obtain good coverage on every tiller in the hill with a pneumatic knapsack sprayer. Therefore, in order to procure better control of the pest, other methods of applying insecticides should be studied. With this view point, the following soil treatment trials were conducted.

SOIL TREATMENT TRIALS.—Two trials were made using Taichung No. 65 variety planted in pots. In both trials chemicals were applied on the surface of the soil surrounding the hill after drainage of irrigation water; then they were lightly plowed into the soil. Heading of the plants started several days after application of insecticides in both tests. About 60 newly hatched larvae were released per hill 13 days after treatments in trial one, and 14 days after in trial two. The results were examined 5 days after releasing the larvae and are given in tables 6 and 7. It is found from the data in table 6 that all chemicals were still quite effective 13 days after treatment. Lindane appeared to be much better than other chemicals. Data in table 7 show that residual effect of Sumithion, endrin, parathion, and EPN applied in the soil appears to vary considerably according to different conditions of the tillers and possibly to some other conditions. However,

Table 5. Residual effect of some insecticides for preventing the newly hatched paddy borer larvae from damaging the second paddy crop at the heading stage. Taipei. 1961. (1 to 5 hills examided per treatment)

Treatment and Concentration (%)	No. Of Tillers Injured/Total Examined (Larvae released at indicated days after spraying)					
	6	7	8	9	10	11
Test 1, sprayed on Sept. 1[a]. (Max. temp. 34°C.)						
Untreated	4/82	—	—	—	—	23/151
Sumithion 0.1	1/90	—	—	—	—	8/174
0.05	1/72	—	—	—	—	20/152
Sumithion 0.1 Plus Endrin 0.04	0/71	—	—	—	—	14/153
Sumitnion 0.05 Plus Endrin 0.04	0/76	—	—	—	—	18/166
Sumitnion 0.1 Plus Endrin 0.02	2/88	—	—	—	—	39/169
Sumitnion 0.05 Plus Endrin 0.02	0/74	—	—	—	—	32/146
Endrin 0.04	1/81	—	—	—	—	19/148
0.02	0/70	—	—	—	—	40/153
Parathion 0.05	0/68	—	—	—	—	36/161
0.025	1/91	—	—	—	—	14/160
EPN 0.05	0/83	—	—	—	—	22/153
0.025	0/73	—	—	—	—	28/156
Test 2, sprayed on Oct. 8. (Max. temp. 33°C.)						
Untreated	—	2/85	—	3/44	—	13/83
Sumitnion 0.1	—	1/75	—	0/36	—	5/73
0.05	—	3/72	—	0/38	—	6/69
Sumitnion 0.1 Plus Endrin 0.04	—	2/76	—	0/40	—	5/74
Sumithion 0.05 Plus Endrin 0.04	—	0/63	—	0/39	—	7/63
Sumithion 0.1 Plus Endrin 0.02	—	0/65	—	0/38	—	0/65
Sumithion 0.05 Plus Endrin 0.02	—	0/70	—	0/40	—	3/70
Endrin 0.04	—	0/66	—	0/36	—	7/66
0.02	—	0/70	—	0/36	—	4/70
Parathion 0.05	—	0/65	—	0/33	—	1/65
0.025	—	0/72	—	0/42	—	14/72
EPN 0.05	—	1/79	—	0/59	—	5/78
0.025	—	0/78	—	0/57	—	3/78
Test 3, sprayed on Oct. 12. (Variety Tainon No. 8) (Max. temp. 33°C.)						
Untreated	3/48	—	5/51	—	9/65	—
Sumithion 0.1	4/42	—	5/49	—	7/60	—
0.05	6/42	—	5/47	—	11/60	—
Sumithion 0.1 Plus Endrin 0.04	1/39	—	2/52	—	5/63	—
Sumithion 0.05 Plus Endrin 0.04	0/28	—	4/56	—	9/52	—
Sumithion 0.1 Plus Endrin 0.02	1/39	—	7/51	—	8/63	—
Sumithion 0.05 Plus Endrin 0.02	5/35	—	7/53	—	7/56	—
Endrin 0.04	2/42	—	5/47	—	12/63	—
0.02	3/42	—	1/46	—	9/64	—
Parathion 0.05	3/41	—	4/49	—	4/57	—
0.025	1/36	—	1/52	—	6/69	—
EPN 0.05	2/45	—	1/49	—	8/73	—
0.025	0/44	—	5/57	—	10/68	—

[a] The plants were caught in a typhoon 10 days after spraying.

lindane does not seem to vary as great as other chemicals and again showed the best effect. The results of these trails show that the chemicals tested as a soil treatment appear to loose their effect quite soon except lindane dust at the dosages used. Further tests are needed on the effect of soil treatments.

Table 6. Residual effect of several insecticides applied in the soil for preventing newly hatched paddy borer larvae from damaging the paddy plants at the heading stage. Treated on Sept. 1, 1961. Taipei. (2 hills sxamined per treatment)

Compound and Concentration (%)	Dosage Per Hill	No. Of Tillers Damaged/Total Examined (Larvae released 13 days after treatment)	
Untreated		6/34	5/28
Sumitnion e.c. 0.05	30 cc	0/21	2/22
Endrin e.c. 0.05	30 cc	1/34	3/25
Endrin dust 3.0	5 g	1/22	2/37
Lindane dust 3.0	5 g	0/22	0/32

Table 7. Residual effect of some insecticides applied in the soil for preventing the newly hatched paddy borer larvae from damaging the paddy plants at the heading stage. Treated Oct. 12, 1961. (Larvae released 14 days after treatment; examined on 4 hills per treatment)

Compound and Concentration (%)	Dosage Per Hill	No. Of Tillers Infested With Living Larvae /Total Examined	No. Of Tillers Infested But The Larvae Killed /Total Examined
A, examined on effective tillers with ears.			
Untreated		10/70	4/70
Sumithion e.c. 0.05	30 cc.	20/80	8/80
Endrin e.c. 0.05	30 cc.	10/73	5/73
Parathion e.c. 0.05	30 cc.	20/79	3/79
EPN e.c. 0.05	30 cc.	25/65	6/65
Lindane dust 3.0	5 g.	3/90	14/90
B, examined on ineffective tillers.			
Untreated		2/6	2/6
Sumithion e.c. 0.05	30 cc.	2/12	5/12
Endrin e.c. 0.05	30 cc.	0/9	5/9
Parathion e.c. 0.05	30 cc.	4/25	9/25
EPN e.c. 0.05	30 cc.	0/17	8/17
Lindane dust 3.0	5 g.	0/16	2/16

FIELD TESTS.—Field tests were conducted on the second crops in Chiayi and Taipei. The paddy plants used for the test in Chiayi was variety Chianon No. 8, transplanted on July 11th. Sprays were applied on Sept. 11 at the rate of 1,200 l.

per hectare with a pneumatic knapsack sprayer at the pressure of about 40 p. s. i. The treatments were randomized and replicated four times. Each test plot was about 0.005 are in area containing 1,000 hills of the plants. The plants were caught in a typhoon about 12 hours after spraying. Heading started several days after treatment. The results were examined on Sept. 30th by counting the number of the white ears. The plants used for the test in Taipei was variety Tainon No. 8, transplanted on Augest 23. Sprays were applied on Oct. 7th and 8th at the rate of 1,200 l. per hectare with a pneumatic knapsack sprayer at the pressue of about 40 p. s. i. The treatment were randomized and replicated 6 times. The test plot was about 0.005 a. in area containing 1,000 hills of the plants. Heading of the plants started about 10 days after treatment. The results were examined on Oct. 24 by counting the number of the white ears. It was found that although 1,200 l. of spray per hectare has been the recommended amount, the deposits of spray on the stems were only fractional when applied with a pneumatic sprayer at the pressure of 40 p. s. i. The data of these tests were given in table 8.

Table 8. Field tests of the paddy borer control with some insecticides applied as a foliar spray at the rate of 1,200 l./hec.

Treatment and Concentration (%)	Per Cent Of White Ears Caused Primarily By The Paddy Borer[a]						
	Replicate						Average
	I	II	III	IV	V	VI	
Test in Chiayi, sprayed Sept. 11							
Untreated	0.99	0.89	1.48	1.08	—	—	1.11
Sumithion 0.1	0.99	0.16	1.27	0.44	—	—	0.71
Sumithion 0.05	0.16	0.38	0.25	0.15	—	—	0.24
Sumithion 0.05 Plus Endrin 0.05	0.10	0.14	0.22	1.03	—	—	0.37
Endrin 0.05	1.36	0.71	0.05	0.24	—	—	0.59
Parathion 0.05	0.86	0.83	0.58	0.38	—	—	0.66
Test in Taipei, sprayed Oct. 7 and 8							
Untreated	1.57	0.23	0.53	0.39	0.38	0.23	0.56
Sumithion 0.1	0.37	0.42	0.53	0.13	0.10	0.40	0.33
Sumithion 0.05	0.76	0.32	0.30	0.17	0.31	0.87	0.46
Sumithion 0.05 Plus Endrin 0.05	0.20	0.10	0.29	0.25	0.12	0.73	0.28
Endrin 0.05	0.36	0.17	0.12	0.28	0.42	0.26	0.27
Parathion 0.05	0.73	0.51	0.34	0.48	0.23	0.68	0.50

[a] Some of the white ears were caused by the rice stem borer, *Chilo suppressalis*.

The difference in percentage of the white ears caused by the pest between treatment was statistically analyzed and the results were given in table 9.

Table 9. Analysis of variance

Source Of Variation	D.F	Sum Of Square	Mean Square	F	Point Of Significance	
					5%	1%
Test in Taipei						
Treatment	5	0.4541	0.0908	1.4885	2.60	3.86
Replication	5	0.7180	0.1436	2.3541		
Eror	25	1.5249	0.0610			
Total	35	2.7960				
Test in Chiayi						
Treatment	5	1.8445	0.3689	2.2659	2.90	4.56
Replication	3	0.3189	0.1063	0.6529		
Eror	15	2.4420	0.1628			
Total	23	4.6054				

It is found from the data in table 9 that difference between treatments was not significant in both tests conducted in Chiayi and Taipei. This seemed to be due to various causes such as heading of the plants, the typhoon (in Chiayi), low population of the pest during the test period, too long interval of time between treatment and examination of the results during which period the insecticides used lost their residual effect, and inappropriate method of applying sprays (insufficient deposits of the toxicants on the stems). At any rate, before trying to conduct reliable field tests of comparative effectiveness of insecticides it seems necessary first to make detailed studies on timing of applying chemicals, methods of application, use of indicators for evaluating the effect of insecticides.

DISCUSSION AND CONCLUSIONS.—The data obtained in the present work indicate that when higher dosages (0.1%, 17 cc per hill) are used Sumithion appears to give somewhat better residual control of the borer. Yet, it seems difficult to obtain the persistence over 7 days with this material even at such a relatively higher dosage. Better residual control of the pest is obtained when Sumithion is combined with endrin; in this case 0.05 and 0.02 per cent appear to be adequate for Sumithion and endrin respectively. Endrin in this test again showed variable residual activity, and parathion gave rather poor residual control. On the other hand EPN exhibited promising results.

When applied in the soil at the heading stage of the plants lindane dust (3%, 5g. per hill) showed superior residual control to parathion, EPN, Sumithion and endrin (0.05% emulsions, 30 cc. per hill).

It was found from the results of these tests and the previous work (Lee, 1961) that residual activity of insecticides tested against the newly hatched larvae varied considerably with stages of growth of paddy plants, and possibly with different external conditions of the plants. At the heading stage many insecticides when applied as a foliar spray showed much poorer residual effect. This seems to be

owing to the fact that the larvae on such plants readily crawl into the lower part of the ear that is still enveloped by the flag leaf sheath and feed in the glumes or the axis of the ear in which little or less toxicant is present. At any rate, it is important when testing residual toxicity of insecticides that plants at different stages of development be used. It is also essential in conducting comparative residual toxicity test of insecticides that tillers in the hill be well standardized. This is especially important when a test is to be conducted in rather inextensive scale.

The results of trails to study mode of action of residues of endrin and parathion indicated that surface residue of endrin did not appear to show any toxic effect on the larvae, while that of parathion soon after spraying seemed to possess a slight toxic action on the newly hatched larvae.

It was found from the results of the field tests that when sprays were applied with a pneumatic knapsack sprayer at the rate of 1,200 l. per hectare and at the pressure of about 40 p. s. i., deposit of the spray on the stem was only fractional, possibly resulting in little insecticidal activity. Therefore, other methods of applying insecticides should be studied.

No significent difference between Sumithion, endrin, parathion, and endrin plus Sumithion treatments was determined in two field tests conducted at Taipei and Chiayi at and before heading stage of the plants. This seemed to be owing to various causes such as heading of the plants, the typhoon, low population density of the pest, too long interval of time between spraying and examination of the results, and inappropriate method of applying insecticides. Before trying to conduct reliable field tests of comparative effectiveness of insecticides it seems necessary first to make detailed studies on timing of applying chemicals, method of application, use of indicators for evaluating the effect of insecticides.

Reference

Lee, Sung-yang. 1961. Tests with Some Insecticides against the Paddy Borer, *Schoenobius incertulas* in Taiwan. Jour. Econ. Ent. 54-4, pp. 707-710.

幾種殺蟲劑對於初孵化三化螟幼蟲之殘效試驗

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中文摘要

前次試驗 (Lee. 1961) Sumithion 對三化螟初孵化幼蟲顯示優異之初效 (initial effect)，但殘效期間則僅約一星期。於本試驗中，Sumithion 以較高濃度或用量使用時 (0.1%，每欉 17 cc)，得到較佳之殘效，然其有效期間似仍不能超過一週。與 endrin 混合使用，殘效可加長，其濃度 Sumithion 0.05%，endrin 0.02%似已足够。Endrin 單獨使用時，其殘效與前次試驗相同，頗有變異。Parathion 之殘效並不理想。EPN 則有希望。

水稻露穗期施行土壤處理，其殘效 lindane粉劑 (3%，每欉 5g) 長於 Parathion, EPN, Sumithion 及 endrin (0.05%乳釋液，每欉 30 cc)。

就各次試驗結果發現，水稻之生長期影響藥劑對三化螟初孵化幼蟲之殘效頗大。植株外部狀態似亦有此可能。

在水稻露穗時噴藥，多種藥劑之殘效均不理想。此或由於幼蟲常侵入嫩穗 (於苞鞘中) 嚙食花器及穗軸所致，此時該部份仍包藏於苞鞘之內，藥毒滲入者可能甚少，甚或全無藥劑存在。因此從事殘效試驗時，各種生長狀態之水稻均需一一比較，每欉各株間之生長情形亦應力求統一，小規模試驗尤應注意此點。

由 endrin 和 parathion 之殘留成分作用程序 (mode of action) 之初步試驗結果顯示，endrin 之表面殘留成分對三化螟初孵化幼蟲脚部之接觸和蟲體燻蒸不引起毒效。噴後不久之 parathion 似乎有些微之毒作用，唯由接觸或燻蒸何者所引起，尙未探悉。

田間試驗時發現，以自動式噴霧器，壓力約 40 p. s. i.，在每公頃 1,200 公升之藥量下噴於水稻，其莖部着藥量甚少，此可能爲藥劑防治效果不良原因之一，因此，藥劑之施佈方法有加以研究之必要。

在臺北地區水稻近露穗及嘉義地區水稻露穗時所進行之田間藥劑試驗，未得顯著結果 (使用藥劑爲 Sumithion, endrin, parathion 及 Sumithion 加 endrin)。其可能之原因甚多，例如正出穗之水稻，遭遇颱風，自然被害率太低，噴藥至調查結果相隔時日過長或噴藥方法不適當等等。故於進行田間藥劑比較試驗之前，似應先予充分研究噴藥時期，用藥方法及如何使用指示物以測定試驗結果等問題。